# Centipedes from Italian Agroecosystems and their Possible Value as Pest Control Agents

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ABSTRACT

The centipede communities of agroecosytems (vineyard, hazel-grove, olive-grove, chestnut-grove) and woodland stands (*Castanea sativa* coppiced wood, *Quercus cerris* woods) in Central Italy were studied in 1984-1991 by pitfall-trapping for one year in each site. Nineteen species were collected. In the agroecosystems the number of species ranges from 2 (vineyard) to 7 (hazel-grove) whereas in oak woods 7 to 10 species were collected. *Lithobius lapidicola* Meinert and *L. forficatus* (Linné) are the most common species in the agroecosystems. An attempt to assess the possible value of this group as pest control agent is discussed.

RÉSUMÉ

**Les chilopodes d'agroécosystèmes d'Italie et leur valeur possible en tant qu'agents contrôlant les ravageurs.**

Des recherches ont été menées sur des peuplements de chilopodes dans des agroécosystèmes (vignes, bosquets de noisetiers, oliveraies, châtaigneraies) et des sites forestiers (taillis de châtaigniers, *Castanea sativa*, forêts de chênes, *Quercus cerris*) du centre de l'Italie. Les études ont été réalisées de 1984 à 1991 à l'aide de pièges d'interception durant un an sur chaque site. 19 espèces ont été récoltées. Dans les agroécosystèmes, le nombre des espèces varie de 2 (vignes) à 7 (noisetiers) alors que dans les forêts de chênes, on trouve de 7 à 10 espèces. *Lithobius lapidicola* Meinert et *Lithobius forficatus* (Linné) sont les espèces les plus communes dans les agroécosystèmes. Une tentative d'accorder à ces groupes une valeur d'agent de contrôle des ravageurs est discutée.

## INTRODUCTION

The centipede communities of Italian agroecosystems are little known and the few data available are mostly synthetized in MINELLI & IOVANE (1987). Other informations are in DACCORDI & ZANETTI (1987) on NE Italy vineyard, PAOLETTI (1988) on NE Italy maize monocultures, and ZAPPAROLI & TREMATERRA (1993) on N Italy apple orchads. Data concerning chilopods as a component of the soil community are in PAOLETTI (1980, 1988), on NE Italy maize agroecosystems, JONA LASINIO & ZAPPAROLI (1993) and TESTA & ZAPPAROLI (1994), on olive-grove and on hazelnut-grove in Central Italy.

The aim of this paper is (i) to describe the centipede communities in some agroecosystems of Central Italy, (ii) to verify the influence of the agricultural and sylvicultural activities on the qualitative composition of such communities and (iii) to assess the possible role of these polyphagous predators as pest control agent in integrated control programs.

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## SAMPLING SITES AND METHODS

*Sampling sites*

Nine sites have been sampled in different localities of the Viterbo province, Latium, Central Italy: sites 1-7 are agroecosystems, representative of the predominant cultivations of the area, sites 8-9 are natural or seminatural stands, representative of the local forest vegetation potentially occurring at the same altitudinal level. The main characteristics of each site are summarized below :

1) Bassano in Teverina, 300 m a.s.l., a 15 year old vineyard, 5 ha, E exposure, bordering on open cultivated fields. Agronomic practices: chemical manures in March, May; fungicide treatments all over the cultural cycle, cultivations in spring and summer, no insecticide and herbicide treatment.

2) Caprarola, Mt. Venere, 500 m a.s.l., a 25-30 year old hazel-grove, 4 ha, SE exposure, bordering on broadleaved mixed woods and hazel-groves (see also TESTA & ZAPPAROLI, 1994). Agronomic practices: chemical manures in February, cultivations in April, May, August, insecticide treatments (Endosulfan 100 g/1000 l $H_2O$) in May, June, July, herbicide treatments (Glyphosate) in July, September.

3) Soriano al Cimino, St. Eutizio, 350 m a.s.l., a 20 year old hazel-grove, 3 ha, SE exposition, bordering on hazel-groves (see also TESTA & ZAPPAROLI, 1994). Agronomic practices: chemical manures in February, cultivations in April, May, June, July, August, no insecticide and herbicide treatments.

4) Canino, 120 m a.s.l., a 35-40 year old olive-grove, 4 ha, W exposure, bordering on open cultivated and grazed areas (see also JONA LASINIO & ZAPPAROLI, 1993). No agronomic practices.

5) Soriano al Cimino, St. Eutizio, 350 m a.s.l., chestnut-grove, 1 ha, W exposure, bordering on chestnut-groves and hazel-groves. Agronomic practices: cultivations in May, September, no insecticide and herbicide treatments.

6) Canepina, 650 m a.s.l., chestnut-grove, 4 ha, SE exposure, bordering on chestnut-groves. Agronomic practices: cultivations in May and September, no insecticide and herbicide treatements.

7) Caprarola, Poggio Nibbio, 550 m a.s.l., *Castanea sativa* coppiced wood, SW exposure.

8) Caprarola, Mt. Venere, 560 m a.s.l., *Quercus cerris* wood with *Ostrya carpinifolia* and *Acer obtusatum*, E exposure.

9) Caprarola, Poggio Nibbio, 580 m a.s.l., *Q. cerris* coppiced wood, SW exposure.

The area is marked by Mediterranean temperate climate, with a mean annual rainfall ranging from 700 to 1400 mm, max in October-November, min in July, mean annual temperature = 14.8 °C, max in July, min in December, aridity period in July/August. The Mediterranean characteristics of the climate in site 4 (Canino, olive-grove) are stronger than the other sites, according to its geographic position closer to the Thyrrenian sea coast. The geological substratum of the whole area is of volcanic origin (Pleistocenic), soils are clayey (TESTA & ZAPPAROLI, 1994).

*Methods*

Sampling has been carried out between 1984-1991 by pitfall trapping (see JONA LASINIO & ZAPPAROLI, 1993). Six traps with a 4% solution of formaldehyde in vinegar are positioned in each site for one year. Traps have been located at about 10 m one from the other along one or two rows, generally at the bases of trees, and emptied monthly. Because of limitations in the use of pitfall traps, especially for Scolopendromorpha and Geophilomorpha (ZAPPAROLI, 1992), the results will be discussed mainly qualitatively. The faunistic similarity among the sampling sites has been calculated using the JACCARD (1908) index; the hierarchic classification of the sites was undertaken using the average linkage clustering method (UPGMA).

## RESULTS

Nineteen species of centipedes were collected in the sampling sites with a total of 148 specimens (Table 1). More in detail, 14 species were collected in agroecosystems (sites 1-6), 12 species in the *Quercus cerris* and coppiced *Castanea sativa* stands (sites 7-9). In the agroecosystems the number of species ranges from 2 (site 1, vineyard) to 7 (site 3, hazel-grove), whereas in oak woods 7 (site 9) to 9 (site 8) species were recorded.

A clustering of the nine sampling sites according to the similarities of their centipede fauna (cophenetic correlation index = 0.82) is shown in Figure 1. Cutting the dendrogram at low similarity level (S = 0.20) results in three clusters.

The first cluster groups vineyard and hazel-grove agroecosystems. Euryecious species are generally predominant in these habitats. *L. lapidicola* and *L. forficatus* are the most common centipedes. These species were present in the sampled woodlands as well, but the number of individuals recorded there was lower. Woodland species such as *Cryptops anomalans*, *L. acuminatus*, *L. calcaratus*, *L. castaneus* and *L. tylopus* were represented in hazel-grove as well but infrequent.

TABLE 1. — Centipedes collected in sites sampled (number of ind.). 1 = Bassano in Teverina, vineyard; 2 = Mt. Venere, hazel-grove; 3 = St. Eutizio, hazel-grove; 4 = Canino, olive grove; 5 = St. Eutizo, chestnut-grove; 6 = Canepina, chestnut-grove; 7 = Poggio Nibbio, *Castanea sativa* coppiced wood; 8 = Mt. Venere, *Quercus cerris* wood; 9 = Poggio Nibbio, *Q. cerris* wood. H = habitat preference : e = euryecious species, w = woodland species. C = chorotype : eur = European, sie = Sibiric-european, med = Mediterranean, tem = Turanic-european-mediterranean, wmd = W-Mediterranean.

| species / sites | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | H | C |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Himantarium gabrielis* (Linné) | - | - | - | 1 | - | - | - | - | - | e | med |
| *Henia vesuviana* (Newport) | - | - | - | - | - | - | 2 | 1 | - | w | seu |
| *Schendyla nemorensis* (C. L. Koch) | - | - | - | - | 1 | - | - | 1 | - | w | eur |
| *Geophilus flavus* (De Geer) | - | - | - | - | - | - | - | 2 | - | e | sie |
| *G. linearis* C. L. Koch | - | - | 1 | - | - | - | - | - | - | e | sie |
| *Pachymerium ferrugineum* (C. L. Koch) | - | - | - | - | - | - | - | 1 | - | e | tem |
| *Strigamia crassipes* (C. L. Koch) | - | - | - | - | - | - | - | 2 | 1 | w | eur |
| *Cryptops anomalans* Newport | - | - | 1 | - | - | - | - | - | - | w | eur |
| *C. hortensis* Leach | - | - | - | - | 2 | - | - | - | - | e | eur |
| *C. parisi* Brölemann | - | - | - | - | 3 | 1 | 1 | 2 | 2 | w | eur |
| *Eupolybothrus fasciatus* (Newport) | - | - | - | 3 | - | - | 1 | - | 6 | w | seu |
| *E. nudicornis* (Gervais) | - | - | - | - | - | - | - | 1 | 1 | w | wmd |
| *Lithobius acuminatus* Brölemann | - | 1 | 1 | - | - | 1 | - | - | - | w | eur |
| *L. calcaratus* C. L. Koch | - | 1 | 1 | - | - | 1 | - | - | - | w | eur |
| *L. castaneus* Newport | - | - | 1 | - | - | - | 1 | 2 | 2 | w | seu |
| *L. forficatus* (Linné) | 8 | 12 | 20 | - | 1 | - | 3 | 1 | 2 | e | eur |
| *L. lapidicola* Meinert | 2 | 4 | 8 | - | - | - | - | - | - | e | eur |
| *L. romanus* Meinert | - | - | - | 2 | - | - | - | - | - | w | seu |
| *L. tylopus* Latzel | - | 3 | - | 18 | 2 | 4 | 2 | 1 | 5 | w | seu |
| tot species (19) | 2 | 5 | 7 | 4 | 6 | 3 | 7 | 9 | 8 | | |
| tot specimens (148) | 10 | 21 | 33 | 24 | 10 | 6 | 11 | 13 | 20 | | |
| euriecious spp. % | 100 | 40 | 42.8 | 25 | 33.3 | 0 | 14.3 | 33.4 | 12.5 | 36.8 | |
| woodland spp. % | 0 | 60 | 57.2 | 75 | 66.6 | 100 | 85.7 | 66.6 | 87.5 | 63.2 | |

The second cluster groups together chestnut-groves and wood-land sites. The centipede community recorded in these sites is mostly represented by common woodland species of the broadleaved Central Italy woods, such as *Henia vesuviana*, *Cryptops parisi*, *Eupolybothrus fasciatus*, *Lithobius castaneus* and *L. tylopus.* Other woodland species, such as *Strigamia crassipes* and *E. nudicornis*, are present only in the two *Q. cerris* sampled sites. Anthropophilus or euryecious species, such as *Geophilus flavus*, *Pachymerium ferrugineum* and *L. forficatus*, are also present in the sampled *Q. cerris* and coppiced *C. sativa* woods.

The third cluster is only represented by the olive-grove site. The centipede community is mainly represented here by woodland species, of which *L. tylopus* is the most abundant.

The centipede communities of the sampled agroecosystems seem to be well related to the whole centipede community of the submediterranean-submontane belt of Central Italy, at least in the general features.

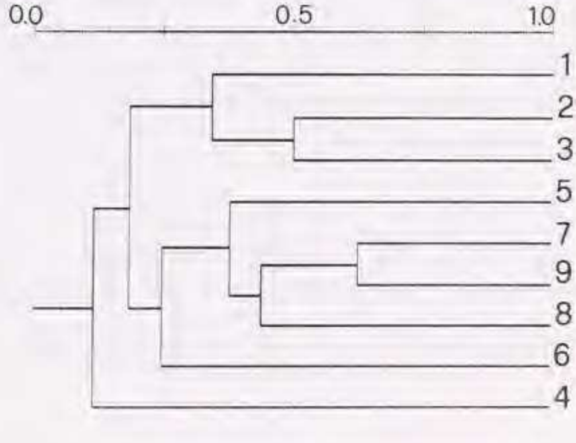


FIG. 1. — Dendrogram of hierarchical classification of the nine sampling sites. See Table 1 for abbreviations.

The anthropic impact on the pre-existent communities seems to be low, especially in chestnut-groves and hazel-groves where some woodland species are represented and a faunistic exchange between the adjacent forest habitats is probably occurring. The lower number of species generally recorded in the agroecosystems, as compared with woodlands, is probably related to the occurence of agronomic pratices, especially of the cultivations. The high frequency of these may induce changes of some soil microconditions, such as humidity degree and litter structure, and changes in community structure may be induced (TESTA & ZAPPAROLI, 1994).

It is of some interest to verify the potential value of centipedes in the control of phytophagous insects partially developing in soil, such as Coleoptera, Diptera and Lepidoptera, in agroecosystems where the stucture of vegetation is similar to that of the forest habitats (ZAPPAROLI & TREMATERRA, 1993). This potential function has already been pointed out for other major polyphagous predator Arthropoda inhabiting open European agroecosystems (cereals, arable field, etc.), such as Aranea, Coleoptera Carabidae and Staphylinidae (BRIGNOLI, 1983; SUNDERLAND & CHAMBERS, 1983). Besides, among Chilopoda especially Lithobiidae have been pointed out as active soil-inhabiting predators in many European and Mediterranean agroecosystems (SUNDERLAND, 1975; CAUSSE, 1976; TEMERAK, 1983).

Among the agroecosystems of the study area, centipedes are generally well represented in species and numbers especially in hazel- and chestnut-groves which represent the most important local cultivations. In hazel-groves, key pest in Central Italy is *Balaninus nucum* L. (Coleoptera Curculionidae), this species completes one generation every 2-5 years and spends part of the biological cycle in soil as mature larval stadium, pupa or adult as well, from June-July to the end of spring, 15-50 cm deep (PUCCI, 1992).

According to the results of the sampling discussed above, the activity peak observed in the centipede communities of the study area matches well with the phenology of the mature larvae and pupae of *B. nucum* (Table 2). Moreover, in hazel-grove centipede community, the most important species from the quantitative point of view is *L. forficatus*, which seems to be active all over the year with a peak in July-September (Table 2). This species is well known as a pioneer in artificial and disturbed European habitats and it also frequently occurs in Italian agroecosystems (MINELLI & IOVANE, 1987; PAOLETTI, 1988; ZAPPAROLI & TREMATERRA, 1993). *L. forficatus* usually preys on a large spectrum of small soft-bodied invertebrates species, mainly arthropods and annelids (LEWIS, 1981) it has been already recorded as an important predator of pupae of *Rhagoletis pomonella* Walsh (Diptera Tephirtidae), a key pest in the Canadian apple ochards (MONTEITH, 1975, 1976).

TABLE 2. — Number of individuals of centipedes (in brakets *L. forficatus*) collected monthly in the sites sampled. 1 = Bassano in Teverina, vineyard; 2 = Mt. Venere, hazel-grove; 3 = St. Eutizio, hazel-grove; 4 = Canino, olive grove; 5 = St. Eutizo, chestnut-grove; 6 = Canepina, chestnut-grove; 7 = Poggio Nibbio, *Castanea sativa* coppiced wood; 8 = Mt. Venere, *Quercus cerris* wood; 9 = Poggio Nibbio, *Q. cerris* wood.

| sites/months | J | F | M | A | M | J | J-A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | 2(1) | 1(1) | 2(2) | 2(2) | 1(1) | 1(-) | 1(1) | - |
| 2 | - | - | 3(-) | - | - | 4(2) | 6(6) | 5(3) | 2(1) | - | 1(-) |
| 3 | - | - | 1(-) | 7(3) | 4(4) | 1(1) | 5(2) | 9(5) | 2(2) | 2(2) | 2(1) |
| 4 | 2(-) | 3(-) | 1(-) | - | - | 2(-) | 8(-) | 5(-) | 1(-) | 2(-) | - |
| 5 | 1(-) | 2(1) | 3(-) | 2(-) | 1(-) | - | - | - | - | 1(-) | - |
| 6 | 2(-) | - | - | 1(-) | - | - | - | - | 3(-) | 2(-) | - |
| 7 | 1(-) | 2(-) | - | - | - | 1(1) | 2(-) | - | - | 3(2) | - |
| 8 | 1(1) | 1(-) | - | - | 2(-) | 1(-) | 3(-) | 1(-) | 1(-) | 2(1) | 2(-) |
| 9 | 1(1) | 2(-) | - | 2(-) | 2(1) | 1(-) | 8(-) | 1(-) | 1(-) | - | 1(-) |

## CONCLUSION

Tentatively, we hypothesize that *L. forficatus* can play an important role among predators in the biocontrol of *B. nucum* in Central Italy hazel-groves.

More evidence is necessary however, to support the possible role of Chilopoda as pest control in agroecosystems. As SUNDERLAND & CHAMBERS (1983) suggest, many problems will have to be solved in order to assess the potential value of such predators: field and laboratory trials on which species are preyed on and the ability to prey are needed together with informations on the predator's behaviour, ecology and density during the years in different sites and under different farming conditions.

On the other hand, as stated by WATERHOUSE (1969), the individual number of centipedes in the field may be too low to give an adequate control of pest. As pointed out by several European studies (see SUNDERLAND & CHAMBERS, 1982; THOMAS *et al.*, 1992), the activity of these predators should therefore be useful in integrated pest control programs in cooperation with other polyphagous Arthropoda, specialist parasites and predators, under more favourable farming conditions such as reduced inputs of pesticides, reduced rates of cultivations and increased and conserved structural diversity within the agroecosystems.

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